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Improving halva quality with dietary fibres of sesame seed coats and date pulp, enriched with emulsifier

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ABSTRACT

Supplementation of halva with waste products of manufacturing, for example defatted sesame seed coats (testae) and date fibre concentrate, can improve its nutritional and organoleptic qualities. These constituents provide high fibre content and technological potential for retaining water and fat. Standard halva supplemented with date fibre concentrate, defatted sesame testae and emulsifier was evaluated for oil separation, texture and colour changes, sensory qualities and acceptability to a taste panel. Addition of both fibres with an emulsifier, improved emulsion stability and increased the hardness of halva significantly. The functional properties of sesame testae and date fibres promote nutrition and health, supplying polyphenol antioxidants and laxative benefits.

1. Introduction

Dietary fibre is the food fraction that evades hydrolysis, digestion and absorption in the small intestine and achieves at least one of the following functions: increases the faecal bulk, stimulates colonic fermentation, reduces postprandial blood glucose and reduces preprandial cholesterol levels (Elleuch et al., 2011). Interest in the role of dietary fibres in health and foodstuffs has prompted a wide range of research and received considerable public attention. It has important therapeutic utility and offers protective health benefits. Dietary fibres can also impart some functional properties to foods, e.g. increase water holding capacity, oil holding capacity, emulsification and/or gel formation. The food industry has drawn upon these functional properties of fibres to improve the viscosity, texture, sensory characteristics and shelf-life of their products (Praznik, Cieslik, & Florkiewicz, 2002; Sáyago-Ayerdi, Brenes, & Goñi, 2009; Soukoulis, Lebesi, & Tzia, 2009). However, the amount of fibre that can be added is finite because it may cause undesirable changes to the colour and texture of foods. The literature contains many reports about the addition of dietary fibre to food products such as baked goods, beverages, confectionery, dairy, frozen dairy, meat, fish, pasta and soups (Elleuch et al., 2011).

By-products of processing fruits and oilseeds, cheap and easily generated in great quantity, can be recovered and used as value-added ingredients. They supply dietary fibre as well as bioactive compounds, such as the polyphenolic antioxidants sesamin and sesamolin (Bedigian, Seigler, & Harlan, 1985; Elleuch, Besbes, Roiseux, Blecker, & Attia, 2007; Grougnet et al., 2012), providing economic advantages to the food, cosmetic and pharmaceutical industries. Sesame (*Sesamum indicum* L.) seed coats (testae) and date (*Phoenix dactylifera* L.) fibre concentrates are among the fibre-rich by-products which exhibit useful water and oil holding capacities; therefore, they can be used as ingredients that allow for the stabilisation of foodstuffs rich in water and fat, in particular, halva (Elleuch et al., 2008; Elleuch, Bedigian, Besbes, Blecker, & Attia, 2012). Sesame testae provide additional medicinal and nutritional enrichment by contributing high levels of polyphenol antioxidant-rich dietary lignans (Bedigian, 2011a,b; Grougnet, Magiatis, Mitakou, & Skaltsounis, 2011; Grougnet et al., 2006) that also have antimutagenic properties (Lazarou, Grougnet, & Papadopoulos, 2007; Mak, Chiu, & Ko, 2011; Sacco & Thompson, 2011).

Halva (halaweh, halvah, from Arabic halwā), a dense crystallised paste (tahin, tahini) of sweetened sesame seeds is a common confectionary food in the Balkans, Greece, Tunisia and across South West Asia, prepared with dehulled, roasted and milled white sesame seeds (tahin), sugars (sucrose and glucose syrup), citric acid

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and soapwort (*Saponaria officinalis* L.) root (Bedigian, 2004). Roasting sesame seeds, the most significant step in halva processing (Bedigian, 2004; Bedigian, 2011a,b), improves their functional properties, and increasing flavour and colour, improves their sensory quality (Akbulut & Çoklar, 2009). Dehulling removes relatively large amounts of anti-nutritional oxalic acid and fibre contained in the testae, which results in lighter coloured, less bitter-tasting seeds.

Some manufacturers add natural ingredients to halva to boost flavour, colour and emulsion stability, e.g., vanilla, chocolate, almonds or pistachio nuts. Others occasionally add the whitening agent titanium dioxide (E171) (Elleuch, Bedigian, & Zitoun, 2011) and palm oil at the kneading stage (Goulas, Zygoura, Karatapanis, Georgantelis, & Kontominas, 2007). Alternative sweeteners, such as honey, date syrup and molasses obtained from grape or mulberry (pekmez), may be substituted. In Turkey, tahin and pekmez are available for sale separately, and the proportion of tahin in blending the mixture is in accordance with consumer preference (Alpaslan & Hayta, 2002). The composition of halva is characteristically high in sugars (47.7%), fat (32.4%), and proteins (13.7%), but low in dietary fibres (1.5%) (Goulas et al., 2007). Oil exudation (separation) during storage leads to a dry texture. The separated oil stains the packaging and reduces marketability.

Ereifej, Rababah, and Al-Rababah (2005) showed that the addition of soy protein concentrate, gelatine, glycerol and lecithin to halva did not improve the emulsion stability at 25 °C and 40 °C. However, calcium chloride, powdered sugar, Gum Arabic and pectin minimised emulsion instability at 25 °C. Furthermore, 1% or 2.5% of non-hydrogenated palm oil increased viscosity of the oil phase and contributed to emulsion stability and prevented oil separation from the halva at 25 °C, but not at 40 °C (Ereifej et al., 2005); they concluded that the mechanism of preventing oil separation seems to be related to an increased viscosity of the oil phase.

The objective of this research was to determine whether incorporating defatted sesame testae, date fibre concentrate and an emulsifier improves the organoleptic, physical and nutritional properties of halva.

2. Materials and methods

2.1. Samples

2.1.1. Fibre preparation

Sesame testae, a waste product produced during the manufacture of the sesame confection halva, were supplied by a Tunisian confectioner, TRIKI-Le Moulin, Sfax. The testae are removed after dehulling the sesame seeds, prior to the preparation of the sesame paste (tahini). The seed coats were dried for 24 h at 40 °C and milled in a RETSCH SK 1 Centrifugal Mill at 2890 rpm to a particle size of less than 1 mm. Defatting was carried out using a Soxhlet apparatus, with *n*-hexane as a solvent. Milled testae were reground in a RETSCH Grindomix GM 200 at 5000 rpm to pass through a 0.2 mm sieve, and then stored at −20 °C for physicochemical analyses and incorporation studies.

Date fibre concentrates were extracted from the Tunisian cultivar 'Allig' as described previously (Elleuch et al., 2008), with some modifications. Dietary fibres from whole fruits were extracted with boiling water for 15 min, using a magnetic stirrer. After solubilisation of the sugars (sucrose, glucose and fructose), date fibres and pits were recovered by filtration through a 0.2 mm sieve. The pits were then removed. The fibres were concentrated by successive rinsing (water at 40 °C) and filtration, until the residue was free of sugars, as described in Section 2.2.1. The residues obtained were pressed dry, dried in oven at 65 °C for 24 h and milled in a RETSCH SK1 Centrifugal Mill at 2890 rpm, then in a RETSCH GM 200 Mill at 5000 rpm until they could pass through a 0.2 mm sieve, to recover the date fibre concentrate, and stored at −18 °C for subsequent physicochemical analyses and incorporation studies.

2.1.2. Halva preparation

Sesame paste (tahin) and the nougat used to produce halva are mass-produced on an industrial scale at the TRIKI-Le Moulin factory, as shown in Fig. 1. Tahin was prepared by grinding dehulled roasted white sesame seeds imported from Sudan. Nougat is an aerated blend of sugars (sucrose and glucose syrup) containing citric acid and soapwort root extract. Tahin at 55 °C and nougat at 90 °C are blended in a KRUPS Prep Expert Series 9000, for 1 min 50 s at speed setting 1, using a kneading hook (these conditions were optimised to approach the halva quality produced on the industrial scale). Defatted sesame testae, date fibre concentrate and emulsifier E471 (industrial mono-acylglycerols of fatty acids, characterised by a high melting point, 80 °C) were incorporated just after the addition of tahin and nougat. This industrially-prepared halva was then transferred into 200 g plastic containers. Two batches of two kilogrammes each were removed for each assay. The different formulations are illustrated in Table 1. The percentage of dietary fibre was determined in preliminary experiments.

2.2. Methods

2.2.1. Chemical analysis

Dry matter was determined by oven drying at 105 °C to a constant weight. Ash was quantified by combustion of the sample in the muffle furnace at 550 °C for 8 h. Fat content was determined by a Soxhlet extraction with hexane for 8 h at the boiling point of the solvent (68–70 °C). The total nitrogen was assessed using the Kjeldahl method; protein was calculated using the standard conversion factor (6.25). Total dietary fibres were determined according to the AOAC enzymatic–gravimetric method of Prosky, Asp, Schweizer, De Vries, and Furda (1988). Sugar content in the clarified sample was analysed with a phenol/sulphuric acid reagent (Dubois, Gilles, Hamilton, Rebers, & Smith, 1956) according to the protocol of clarification defined by the French National organization for Standardisation, AFNOR (Association Française de Normalisation).

2.3. Physical analysis

2.3.1. Particle size distribution of fibres

The particle size distribution was determined in 100 g of fibre using a RETSCH Analytical Sieve Shaker AS 200 Control-g, agitated at the rate of 1.50 mm/"g", at 15 s intervals for 20 min.

2.3.2. Bulk density measurement of fibres

Bulk density was calculated as weight of sample per unit volume of sample (g/ml).

2.3.3. Water – and oil holding capacities of fibres

Water holding capacity (WHC) and oil holding capacity (OHC) of the fibres were determined according to the methods of MacConnell, Eastwood, and Mitchell (1997) and Caprez, Arrigoni, Amado, and Zeukom (1986), respectively. The values were expressed as grams of water absorbed per gram of sample for the WHC and grams of oil absorbed per gram of sample for the OHC.

2.3.4. Colour measurement

Colour measurements were carried out using a Konica Minolta CR-300 Chroma Meter to determine L^*, a^* and b^* values. The L^* value indicates colour lightness, i.e., on a scale of 0–100, a higher number indicates lighter colour; the a^* value gives the span of red–green colour, with a higher positive a^* value signifying more